STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURES

FOR

AIR QUALITY MONITORING

APPENDIX P

SIERRA-ANDERSEN 1200
SIZE SELECTIVE INLET PM10 SAMPLER

MONITORING AND LABORATORY DIVISION
JULY 1997

APPENDIX P

SIERRA-ANDERSEN 1200
SIZE SELECTIVE INLET PM10 SAMPLER

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STATE OF CALIFORNIA

AIR RESOURCES BOARD

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VOLUME II

STANDARD OPERATING PROCEDURES

FOR

AIR QUALITY MONITORING

APPENDIX P.1

STATION OPERATOR'S PROCEDURES
FOR
SIERRA-ANDERSEN 1200
SIZE SELECTIVE INLET PM10 SAMPLER

MONITORING AND LABORATORY DIVISION

JULY 1997

P.1.0 GENERAL INFORMATION

P.1.0.1 SYSTEM OPERATION

The PM10 sampler draws air into a specially shaped inlet at 40 CFM. The standard flow rate is altitude dependent. PM10 particulate matter collects on an 8" x 10" matted quartz fiber surface. The concentration of PM10 particulate matter (in micrograms per cubic meter) is calculated by weighing the collected particulates and dividing by the measured volume of air sampled. The standard sampling frequency is every sixth day for a 24 hour period.

P.1.0.2 PHYSICAL DESCRIPTION

A cross-sectional drawing of the Sierra-Andersen Model 1200 single stage size selective inlet head, with greased shim, is shown in Figure P.1.0.1. The inlet head is symmetric and therefore insensitive to wind direction, and has been determined to be relatively insensitive to wind speed. The air is drawn through the acceleration nozzles at 40 CFM. Particles larger than 10 μm (aerodynamic diameter) cannot follow the air stream as they are deflected below the nozzles and fall onto the flat surface of the greased shim below the nozzles. The air sample is then drawn through vent tubes, and then through the filter, where the inhalable particulate matter is collected. The height of the vent tube inlets above the acceleration nozzle plate and the use of the greased shim prevents re-entrainment of particles larger than 10 μm. The remainder of the sampler for the Model 1200 (filter, blower, timer, cabinet, etc.) is identical to the standard high volume sampler.

P.1.0.3 SYSTEM START-UP

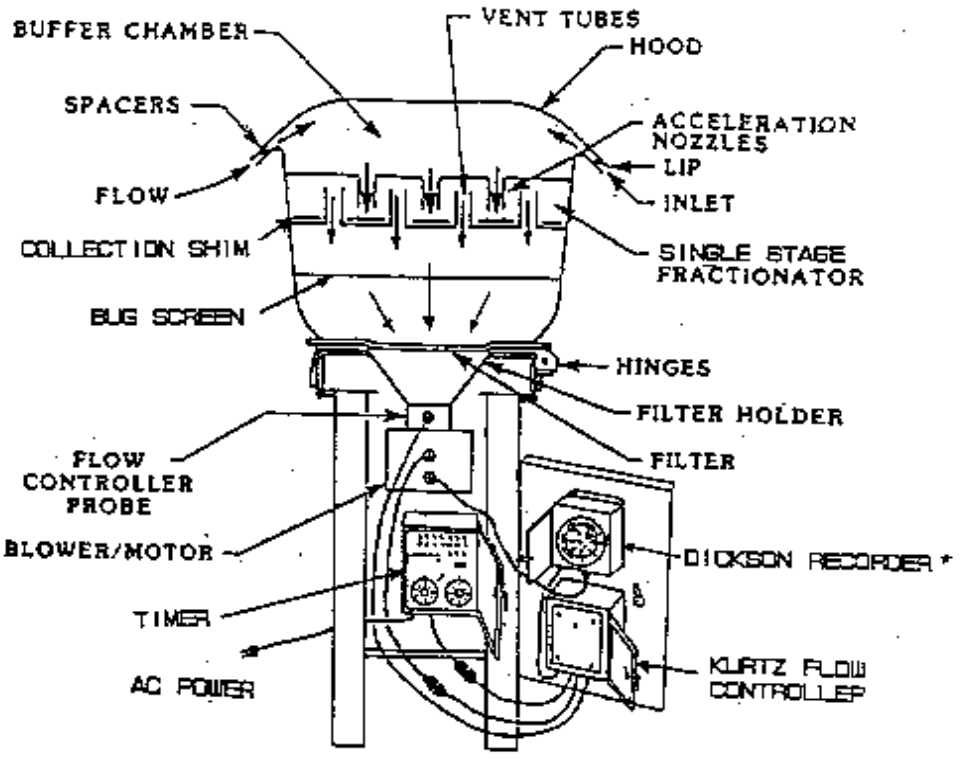
1. Fill out a site report for the PM10 sampler and send it to your supervisor for review for compliance with SLAM PM10 siting criteria (40 CFR Part 58, Appendix E). A completed site report must be on file with MLD prior to acceptance of data into the California Air Quality Data Bank.

2. Calibrate the PM10 sampler as per Appendix P.2 of this Manual.

P.1.0.4 CAUTIONS

1. The matted quartz fiber filter is very delicate and can be easily torn or gouged. Handle carefully by the edges. Damaged filters will be invalidated.

2. To avoid electrical shock, disconnect the 115V AC power before working on the motor.



* NOTE: Recorder location may be switched with that of Flow Controller at some field stations.

Figure P.1.0.1
PM10 Sampler

P.1.1 SAMPLING PROCEDURE

P.1.1.1 SAMPLING FREQUENCY

The PM10 samplers are run on a six-day sampling schedule as specified by the Environmental Protection Agency (EPA). For certain projects, the frequency may be increased to daily sampling. Table P.1.1.1 specifies ARB's standard six-day sampling schedule. The sampling duration is 24 hours, 0001 to 2359 hours PST. Special sampling (sulfates, etc.) may require varied time schedules and other than the 0001 hour starting time.

P.1.1.2 PRE-RUN PROCEDURE

1. 24-Hour PM10 Air Sample Report - Prior to each run, record on the Air Sample Report the reporting agency, station address, calibration date, station name, instrument number and county, site, agency and project codes. Figure P.1.1.1 shows the Air Sample Report, Form MLD-13. The Air Sample Report is provided with each pre-weighed filter.

2. Clean Unexposed Filter Installation - The Model 1200 is equipped to use a portable filter cartridge (FC) to protect the fragile filter during installation under windy conditions. The clean, unexposed filter should be installed in the FC inside a clean monitoring station or a clean office before being transported to the sampling site. Place the numbered side of the filter facing down. When handling quartz PM10 filters during the FC loading and unloading operations, avoid contamination of the filter. The clean, unexposed, pre-weighed filter should be carefully placed on the stainless steel screen of the FC and secured in place by the hold-down frame. Care should be taken to install the filter evenly on the frame so the exposed area is parallel with the filter sides. Install the windscreen cover on the FC and transport the loaded FC to the sampler and place it over the 8" x 10" mount and attach it to the bottom base plate with four swing bolts and nuts. Close the SSI hinged top and tighten down the swing nuts to seal the 8" x 10" SSI base gasket to the top of the FC. Do not over tighten or it may result in deformation of the faceplate gasket.

3. Initial Flow Meter Reading - Prior to each run, it must be verified that the sampler flow rate is at the setpoint value (within 5 percent) listed in Table P.2.0.1, as described in the following paragraph.

4. Record the filter number, station number, and run date on the back of the Circular chart. Carefully insert the new chart into the recorder. Center the tab on the slotted drive (turn the chart if necessary) so that the chart will rotate the full 360 degrees without binding or slipping. If an uneven chart is encountered, it may be required to cut approximately 1/8" off the circumference of the chart to prevent binding. Rotate the chart so that the pen head rests on the predetermined start time (usually 0001 hours) if the chart drive on the recorder does not run continuously, or to the current standard time if the chart drive runs continuously. Check the zero flow rate setting on the chart. If the pen is not at 0 CFM, tap the recorder lightly to verify that the pen is free. If it still does not zero, do **NOT** reset the pen to zero, which will invalidate the calibration. Turn on the sampler, tap the recorder lightly, and allow it to run for 5 minutes. Determine the initial flow meter reading (see Section P.1.2.2).

   NOTE: Record the upper and lower (5 percent) tolerance limits for the flow rate on the Monthly Checksheet. These are tolerance limits for setting purposes. The accept/reject criteria is ± 10%.

5. Timer Setting - Set the timer clock to start at the pre- determined start time on the designated date, and to shut off 24 hours later, as follows:

   a. Dayton or Paragon Seven Day Timer - There are two separate trippers on the dial rim--they are not interchangeable. Place Tripper A at the desired time the sampler should turn on. Place Tripper B at the desired time the sampler should turn off. Trippers must be tight against the dial rim. Tighten tripper screws with fingers only. Grip dial and rotate CLOCKWISE ONLY until current day and time of day appear at the time pointer (do not turn the time pointer). The tripper must be adjusted to give a sample time of 24 hours ±15 minutes.

   b. General Metal Works Timer/Programmer (GMW-800) - Sixth Day Sampling: Place all seven day switches in the **DOWN** position. Reset the indicator light to the fifth from the left position (Thursday) by sequentially pressing the **DAY RESET** switch. Place the sixth **DAY SAMPLE** switch and the sixth from the left day switch (Friday) in the **UP** position. Set the toggle switch between clocks "A" and "B" to the left hand position. The sampling period is now set from midnight of the current day to midnight the following day, and every six days thereafter.

NOTE: When in the sixth day sampling mode, disregard days of the week nomenclature; the days of the week should be regarded as numbered positions only, and do not identify the actual day. At a later date, the IO&S shop is expected to modify the labels. For 24-hour, or episode sampling, refer to the instructions in the Manufacturer's Operating Manual.

24-Hour Sampling (alternate procedure to 4b): With all seven-day switches and the sixth **DAY SAMPLE** switch in the **DOWN** position, reset the indicator light to the present day by sequentially pressing the **DAY RESET** switch. Set the toggle switch between clocks “A" and "B" to the left hand position. The desired sampling day switch is placed in the **UPWARD** position. The sampling period is now set to be from midnight to midnight, on the sample day selected.

c. Elapsed Time Meter - Record the initial elapsed time meter reading on the Monthly Checksheet.

P.1.1.3 POST-RUN PROCEDURE

1. Final Flow Meter Reading - Before removing the filter from the sampler and circular flow chart, make sure that the recorder trace shows the final rate of flow. If not, the sampler must be started to determine the final flow.

   Remove the circular flow chart from the Dickson recorder and examine the trace for abnormalities. Investigate and note any abrupt changes in air flow rate.

2. Exposed Filter Removal - The removable filter cartridge (FC) should be loaded and unloaded at the station operator's headquarters to avoid contamination and damage to the quartz fiber filter media. Install the metal window screen and remove the FC from the sampler and install a second pre-loaded FC in the sampler. After transporting the FC to an inside room, remove the metal windowscreen cover. Then remove the filter from the FC after removing the knurled brass nuts and hold-down frame. Grasp the exposed filter without touching the darkened area and fold it in half, width-wise, with the exposed, darkened side in. When handling quartz PM10 filters during the FC loading

and unloading operations, avoid contamination of the filter. A satisfactory filter is one which has a uniform white border. Dark streaks into the border may indicate an air leak which could invalidate the sample. If the dividing line between dark exposed portion and white unexposed portion of the filter is blurred or not straight, or is undefined, the filter hold down gasket may be leaking or warped, and should be replaced. If there are insects on the filter, remove them carefully with tweezers. Note on the Air Sample Report if the filter is torn or ruptured, if pieces of filter are left sticking to the gasket, if the start or finish times are not known, or if the flows are outside the acceptable range.* Invalidations may be determined by Air Monitoring and Laboratory staff.

3. Timer and Elapsed Time Meter - After each run, check how long the sampler ran by reading the elapsed time meter. Record the final elapsed time meter (ETM) reading on the Monthly Checksheet for each run. These ETM readings are used in calculating the concentration of collected particulates as they are more accurate than the timer or flow chart times.

4. Clock Time - Check the clock time on the dial against a watch to determine if there was a power outage prior to or during the sample run. If a power outage occurred, note this on the 24-Hour PM10 Air Sample Report in the "REMARKS" section. If possible, the length of the power failure should be noted because the run STOP time will be affected. If the length of the power failure is unknown, that should be reported and a make-up run scheduled.

5. 24-Hour PM10 Air Sample Report

    a. Station Name, Elevation, Station Address, Reporting Agency - Enter the station name, elevation, reporting agency, and station address information for the sample run in the appropriate blocks. Note the addition of the new elevation block to the right of the station name block.

* The acceptable range is the value listed in Table P.2.0.1 ($\pm$10 percent).
The acceptable limits of run duration are 24 $\pm$ 1 hours.

b. County, Site, Agency, Project, Instrument No. - Enter the codes for county, site, agency, project and instrument number for the sample run in their respective boxes.

.

c. Sampling Conditions - Enter the one most appropriate letter code which best represents the description of the local sampling conditions during the run in this box. A description of local condition codes are located in the section to the right of the Sampling Conditions box. If a sampling condition exists other than those described from letters A through H (such as snow, sleet, etc.), enter the code Z and explain the sampling condition in the remarks section below. The condition code F should only be used if the run is to be invalidated due to the malfunction of the instrument.

d. Sample Collection Data - It is essential to enter in the start/finish date and time of the sample run as indicated by the Dickson recorder chart.

1. Date - Enter the start and finish sample run date in the boxes provided in sequence of year/month/day. The start date is the day that the run begins. For example: If a run begins before midnight of the scheduled sample run day of May 11, 1990, then enter in |9|0|0|5|1|0|. If a run begins after midnight of the scheduled sample run day of May 11, 1990, enter in |9|0|0|5|1|1|.

2. Time - Enter the start date and finish times in military time in order to differentiate between AM and PM start and finish times.

3. Elapsed Time Meter - Enter the start and finish elapsed time meter readings in the appropriate blocks. Enter the net elapsed time by subtracting the start meter reading from the finish meter reading. If the elapsed time is read in hours, then calculate the time to minutes by multiplying the net elapsed time by sixty (60) and report the value in minutes next to the net time in hours. The net elapsed time should be the total filter run time which includes any "accidental" warm up or flow rate check time during which sample air passed through the filter.

4. Filter Paper Weight - If the filter is being pre- and post-weighed by the Air Resources Board Laboratory, the pre- and post-weight boxes are to be filled in by ARB Laboratory personnel only. If the filter has not been pre-weighed by ARB personnel, enter in the filter pre- and post-weights in the designated boxes.

e. Calibration Data:

1. Date Of Last Calibration - Enter the date of the latest instrument calibration in the boxes provided in the order of year/month/day.

2. Slope - Enter the slope of the current calibration in the boxes provided. This value can be obtained from the latest calibration report for the PM10/SSI sampler.

3. Intercept - Enter the intercept of the current calibration in the boxes provided and include the positive (+) or negative (-) sign. This value can be obtained from the latest calibration report for the PM10/SSI sampler.

f. Indicated Flow Rate - Enter the four indica ted flow rates into their respective boxes. The four flow rates are to be read from the Dickson recorder chart at the times located to the left of each set of boxes; 0200 hours (2:00 AM), 0800 hours (8:00 AM), 1400 hours (2:00 PM) and 2000 hours (8:00 PM) (PST).

g. Average Indicated Flow Rate - The average indicated flow rate is calculated by adding the four indicated flow rates as entered in the boxes labeled "0200," "0800," "1400," and "2000" and dividing the sum by the number four. Enter the calculated average in the box labeled "AVERAGE IND. FLOW RATE". Also, enter this value in the Monthly Quality Control Maintenance Checksheet (Figure P .1.2.1). If the sample run has a run time overlap or run time shortage resulting in more or fewer than four readings, the extra or missing reading should be accounted for in the calculations.

The average flow rate is the sum of all the available flow rates divided by the number of available flow rate samples.

h. Average STD Flow (SCFM) - Enter the average standard (STD) flow rate as standard cubic feet per minute (SCFM) in the box provided. Also, enter this value in the Monthly Quality Control Maintenance Checksheet. There are two methods to calculate the average standard flow rate (SCFM).

1. The most accurate way to calculate SCFM is to use the linear regression values from the latest calibration report for the sampler. This mathematical equation ($y = mx + b$) best represents the calibration curve and alleviates judgement and interpolation errors usually present when calculating values from the graph.

In the equation $y = mx + b$,

y = average standard flow rate (SCFM)
m = slope
x = average indicated flow rate
b = intercept

Therefore, average standard flow rate
(SCFM) = (slope)(average indicated flow rate)+(intercept).

For example: If the average indicated flow rate was 36.2 and the slope and intercept were 1.14 and -1.3 respectively, the average standard flow rate in cubic feet per minute (SCFM) is:

avg. standard flow rate
(SCFM) = (1.14)(36.2) + (-1.3)= (41.268) + (-1.3) = 39.968
= 40.0 SCFM

The above calculation, to determine the average standard flow rate in SCFM, can be performed by multiplying the number previously entered in the "AVERAGE IND. FLOW RATE" box by the number entered in the box labeled

"SLOPE" and adding the resultant product to the number entered in the "INTERCEPT" box. These calculations will also yield the average standard flow rate in standard cubic feet per minute (SCFM).

2. The calibration curve supplied with the sampler calibration data can be used to determine the average standard flow rate (SCFM). Locate the average indicated flow rate, usually on the y-axis (vertical scale), and trace that value horizontally to where it intersects the curve line that relates the indicated flow rate to the standard flow rate. Then, from that point trace the line down vertically to the x-axis (horizontal scale) and read the standard flow rate from the x-axis values which will Equal the average standard flow rate.

i. To Be Completed By PM10 Sampler Operators - Check only one of the two boxes below the heading "To Be Completed By PM10 Sampler Operators".

1. Check the top box only if the sample run meets the quality control standards with the filter and Dickson recorder chart present.

2. Check the bottom box only if sample is invalid because the sample run does not meet quality control standards. Fill in the space provided for the make up schedule date. Check one or more reasons for the invalidation in the places available. If the reason for invalidation is not listed, check the slot marked "other" and state the reason for the invalidation on the line following after.

j. Operator/Phone No. - Enter the operator's name and phone number in the spaces provided. This is crucial information that allows the person most closely in contact with each sample run to be contacted if problems or questions regarding a sample run arise.

k. Remarks - The operator should enter run problems, unusual circumstances and other pertinent information in the remarks section. Sampling condition details, (such as high wind speeds of X mph, etc.) can also be entered in this section. This extra information helps in analysis comparisons of previous runs at the sampling site and same day runs at different sites.

l. PRE-ANA. and POST-ANA. Boxes - If the filter is pre- and post-weighed by the Air Resources Board's Laboratory, then the boxes are for ARB laboratory personnel use only. Enter in the initials of the pre- and post-weight analyst if the filter is not being pre-weighed by ARB laboratory personnel.

NOTE: All spaces, blocks and boxes have a significant purpose and must be filled out completely and correctly. Failure to do so may cause an invalidation of the run.

6. Sample Shipment - Assemble the original copy of the completed 24-Hour PM10 Air Sample Report, the Dickson recorder chart and the exposed filter, folded as described in P.1.1.3 (in the glassine enclosure). Send the assembled package to the Inorganic Laboratory in Sacramento immediately after the sample run. Exposed PM10 filters must be immediately sent to the laboratory for analysis because nitrate and PM10 mass concentrations on acid treated quartz filters can be seriously underestimated if laboratory analysis is conducted more than a few days after sampling. Therefore, the sample filter should reach the laboratory no more than six days after the sample date. The remaining carbon copy of the Air Sample Report should be retained at the station in order to respond to possible inquiries.

In preparing the sample shipment, follow the instructions and diagram shown in Figure P.1.1.3.

a. Handle filters on the unexposed edges whenever possible.

b. Gently fold exposed filter in half (exposed to exposed) before placing in glassine enclosure. Never make a definite crease in the filter.

c. Staple the report form, glassine enclosure, and the Dickson Chart together as indicated in the diagram below. Note that the Dickson

Chart should be facing backwards. In this configuration, the Dickson Chart can be folded upwards so that it can be simultaneously viewed with the report form.

d. Remember to note your calibration slope and intercept values on the report form.

e. Mail exposed filter to the lab as soon as possible.

P.1.1.4 QUALITY CONTROL CRITERIA

Quality control invalidation criteria for PM10 quartz filter samples collected on Size Selective Inlet (SSI) samplers are listed below. All samples collected in the field are to be checked using these criteria. If a sample does not meet these criteria, the sample is invalid. If a **SAMPLE IS INVALIDATED** the **FILTER** and the **COMPLETED REPORT FORM** should be sent to the **LABORATORY** and a **MAKE-UP SAMPLE SCHEDULED FOR THE EARLIEST POSSIBLE DATE**.

1. Filter Contamination - Filters which are dropped or become contaminated by any foreign matter (i.e., dirt, finger marks, ink, liquids, etc.) are invalid.

2. Damaged or Torn Filters - Filters with tears or pinholes which occurred before or during sampling are invalid.

   NOTE: Care should be used when removing a spent filter from the sampler holder. If you tear, rip or otherwise damage a filter when removing it, it is to be considered invalid and a make-up run should be conducted.

3. Sample Flow Rate - If the flow rate through the sampler varies outside the calculated acceptable range for each site for more than one hour during the sampling period, the sample is invalid. This includes irregular flow rate excursions and the sampler warm-up stabilization period.

4. Start/Stop Times - The sampler start and stop time must be 1200 midnight $\pm$ 30 minutes. Please, note that if the Dickson recorder chart indicates the sample began before 2330 hours or after 0030 hours, the sample is invalid unless the operator can determine that the error in start/stop time was the result of an accidental error in the recorder pen alignment. Please note the error and verify the validity of the sample in the comments section of the report form.

5. Sample Run Duration - Sample run duration shall be at least 23 hours and no more than 25 hours. Filter samples collected on samplers which operated for less than 23 hours or more than 25 hours, as documented by the Dickson recorder chart and/or the elapsed time meter, are invalid.

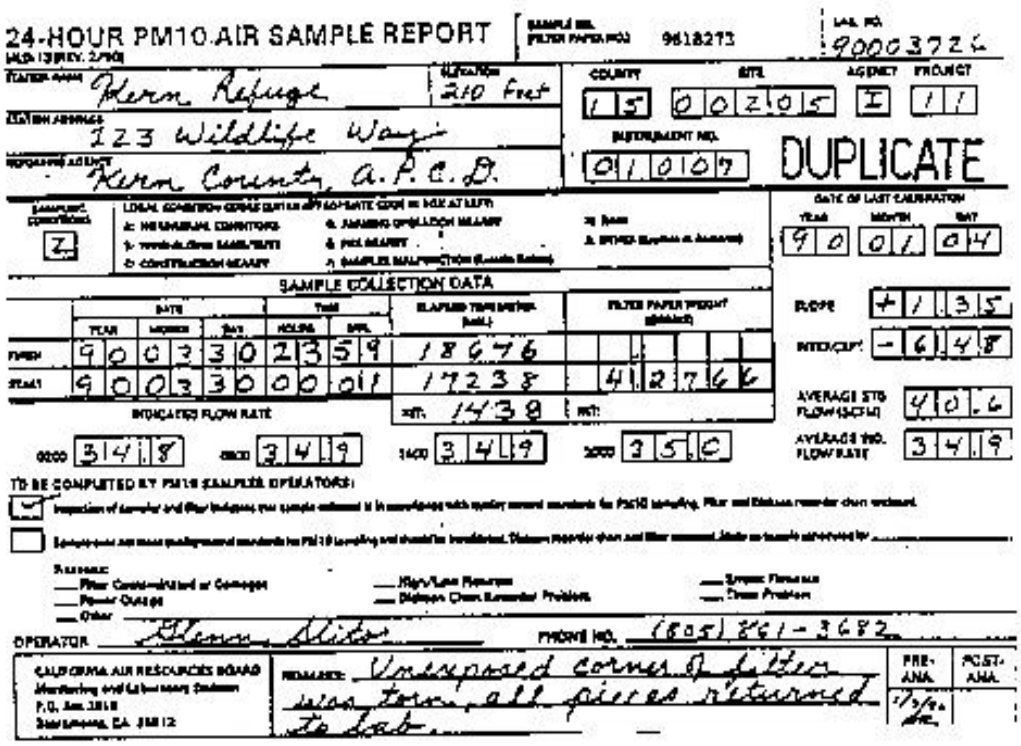
6. Power Failure - If a power failure during a sample run causes the stop time or sample run duration requirements (#4 and #5 above) to be violated, the sample is invalid.

7. Dickson Recorder Chart - A complete Dickson recorder chart, documenting the flow rate through the sampler for 24 hours, must be submitted to the laboratory with each filter sample. Filter samples without a complete Dickson recorder chart record are invalid.

   NOTE: In cases of inking problems where the trace is not complete, if the operator validates the sampler operated properly in the comments section of the report form the sample will be considered valid.

8. Report Form - The filter is considered invalid if a completed 24-Hour Report Form is not included with the sample.

9. Filter Leakage - If the filter shows signs of air leakage due to a worn or improperly seated gasket, the sample will be invalidated.



24-HOUR PM10 AIR SAMPLE REPORT

9618273

9000372L

Kern Refuge

210 Feet

123 Wildlife Way

Kern County, A.P.C.D.

DUPLICATE

SAMPLE COLLECTION DATA

	Date (Year Month Day)	Time (Hour Min)	Elapsed Time Meter	Filter Paper Weight
Finish	90 03 30	23 59	18676	
Start	90 03 30	00 01	17238	4127666
			Net: 1438	Net:

Slope +1.35

Intercept -6.48

Average Std Flow (SCFM) 40.6

Average Ind. Flow Rate 34.9

INDICATED FLOW RATE

0000 31.8 0800 34.9 1400 34.9 2000 35.0

TO BE COMPLETED BY PM10 SAMPLER OPERATORS:

Remarks:
Filter Contaminated or Damaged
Power Outage
Other
High/Low Flowrate
Elapsed Time Exceeded Problem
Erratic Flowrate
Down Problem

OPERATOR Glenn Slitor PHONE NO. (805) 861-3682

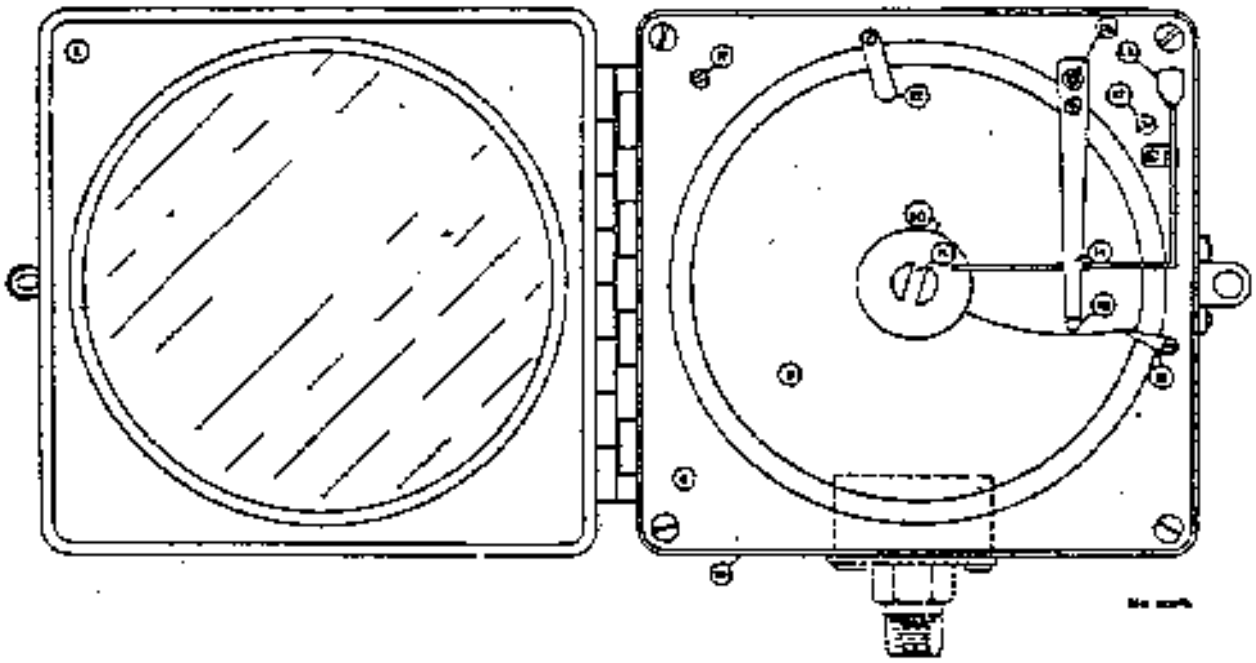
CALIFORNIA AIR RESOURCES BOARD
Monitoring and Laboratory Division
P.O. Box 2815
Sacramento, CA 95812

REMARKS: Unexposed corner of filter was torn, all pieces returned to lab.

PRE-ANA. 12/3/96

POST-ANA.

Figure P.1.1.1
24-Hour PM10 Air Sample Report



2. Door Assembly
8. Instrument Dial Assembly
9. Chart
10. Chart Hub
11. Chart Hub Slot
12. Chart Guide Clip
13. Time Index Clip
14. Pen Arm Assembly
15. "V" Standard Pen Point
16. Pen Arm Shaft Bracket
17. Calibration Adjustment Screw
19. Case Assembly
22. Pen Lifter

Figure P.1.1.2
Dickson Recorder Model No. 1 (4" Diameter Charts)

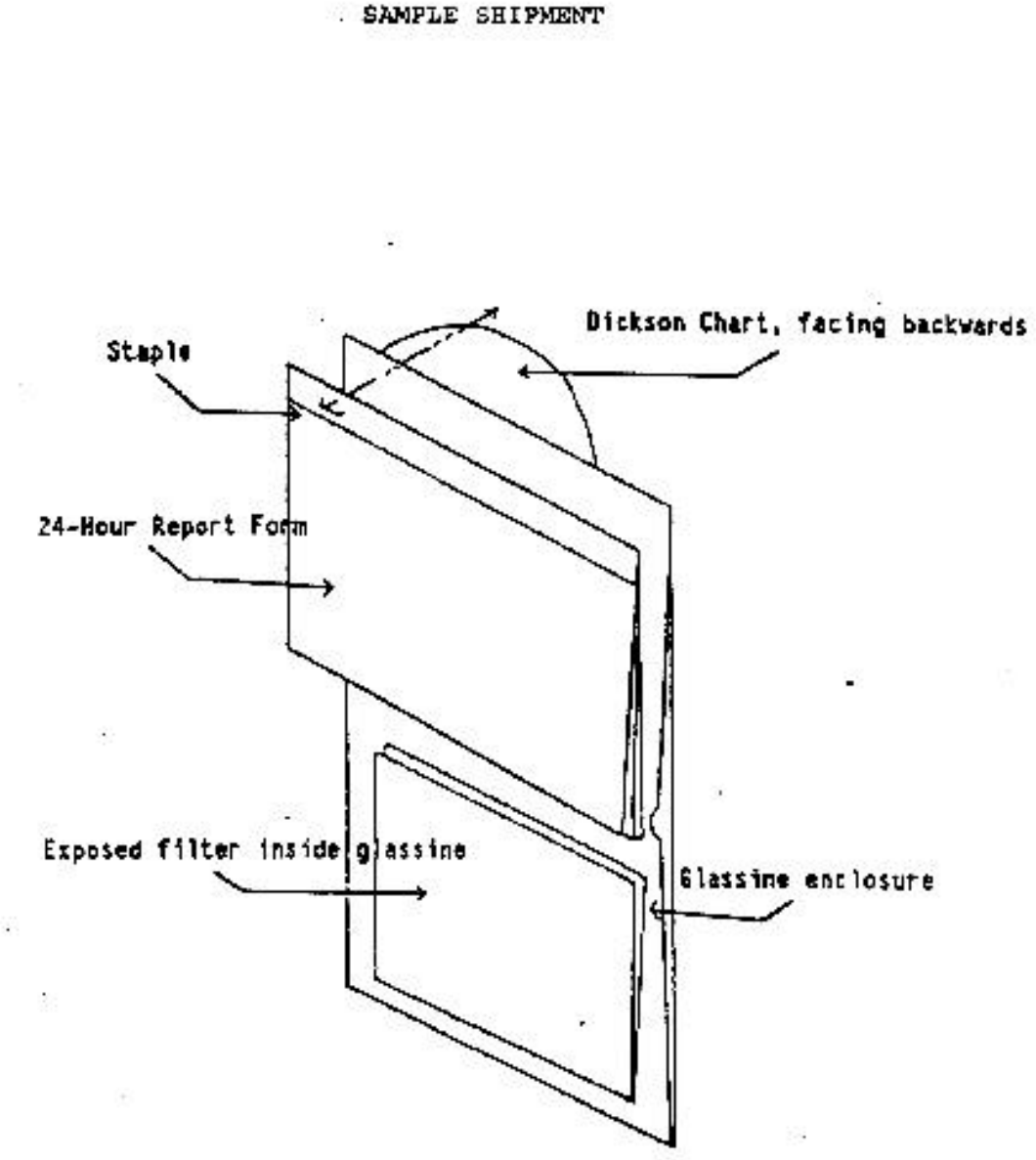


Figure P.1.1.3
Sample Shipment

1997 SAMPLING SCHEDULE

All Sites: Dichot, PM10, Dry Dep

January

S	M	T	W	T	F	S
			1	2	3	(4)
5	6	7	8	9	(10)	11
12	13	14	15	(16)	17	18
19	20	21	(22)	23	24	25
26	27	(28)	29	30	31	

February

S	M	T	W	T	F	S
						1
2	(3)	4	5	6	7	8
(9)	10	11	12	13	14	(15)
16	17	18	19	20	(21)	22
23	24	25	26	(27)	28	

March

S	M	T	W	T	F	S
						1
2	3	4	(5)	6	7	8
9	(10)	(11)	12	13	14	15
16	(17)	18	19	20	21	22
(23)	24	25	26	27	28	(29)
30	31					

April

S	M	T	W	T	F	S
		1	2	3	(4)	5
6	7	8	9	(10)	11	12
13	14	15	(16)	17	18	19
20	21	(22)	23	24	25	26
27	(28)	29	30			

May

S	M	T	W	T	F	S
				1	2	3
(4)	5	6	7	8	9	(10)
11	12	13	14	15	(16)	17
18	19	20	21	(22)	23	24
25	26	27	(28)	29	30	31

June

S	M	T	W	T	F	S
1	2	(3)	4	5	6	7
8	(9)	10	11	12	13	14
(15)	16	17	18	19	20	(21)
22	23	24	25	26	(27)	28
29	30					

July

S	M	T	W	T	F	S
		1	2	(3)	4	5
6	7	8	(9)	10	11	12
13	14	(15)	16	17	18	19
20	(21)	22	23	24	25	26
(27)	28	29	30	31		

August

S	M	T	W	T	F	S
					1	(2)
3	4	5	6	7	(8)	9
10	11	12	13	(14)	15	16
17	18	19	(20)	21	22	23
24	25	(26)	27	28	29	30
31						

September

S	M	T	W	T	F	S
	(1)	2	3	4	5	6
(7)	8	9	10	11	12	(13)
14	15	16	17	18	(19)	20
21	22	23	24	(25)	26	27
28	29	30				

October

S	M	T	W	T	F	S
			(1)	2	3	4
5	6	(7)	8	9	10	11
12	(13)	14	15	16	17	18
(19)	20	21	22	23	24	(25)
26	27	28	29	30	(31)	

November

S	M	T	W	T	F	S
						1
2	3	4	5	(6)	7	8
9	10	11	(12)	13	14	15
16	17	(18)	19	20	21	22
23	(24)	25	26	27	28	29
(30)						

December

S	M	T	W	T	F	S
	1	2	3	4	5	(6)
7	8	9	10	11	(12)	13
14	15	16	17	(18)	19	20
21	22	23	(24)	25	26	27
28	29	(30)	31			

Table P.1.1.1
PM10 Sampling Schedule - 1997

1998 SAMPLING SCHEDULE

All Sites: Dichot, PM10, Dry Dep

January

S	M	T	W	T	F	S
				1	2	3
4	(5)	6	7	8	9	10
(11)	12	13	14	15	16	(17)
18	19	20	21	22	(23)	24
25	26	27	28	(29)	30	31

February

S	M	T	W	T	F	S
1	2	3	(4)	5	6	7
8	9	(10)	11	12	13	14
15	(16)	17	18	19	20	21
(22)	23	24	25	26	27	(28)

March

S	M	T	W	T	F	S
1	2	3	4	5	(6)	7
8	9	10	11	(12)	13	14
15	16	17	(18)	19	20	21
22	23	(24)	25	26	27	28
29	(30)	31				

April

S	M	T	W	T	F	S
			1	2	3	4
(5)	6	7	8	9	10	(11)
12	13	14	15	16	(17)	18
19	20	21	22	(23)	24	25
26	27	28	(29)	30		

May

S	M	T	W	T	F	S
					1	2
3	4	(5)	6	7	8	9
10	(11)	12	13	14	15	16
(17)	18	19	20	21	22	(23)
24	25	26	27	28	(29)	30
31						

June

S	M	T	W	T	F	S
	1	2	3	(4)	5	6
7	8	9	(10)	11	12	13
14	15	(16)	17	18	19	20
21	(22)	23	24	25	26	27
(28)	29	30				

July

S	M	T	W	T	F	S
			1	2	3	(4)
5	6	7	8	9	(10)	11
12	13	14	15	(16)	17	18
19	20	21	(22)	23	24	25
26	27	(28)	29	30	31	

August

S	M	T	W	T	F	S
						1
2	(3)	4	5	6	7	8
(9)	10	11	12	13	14	(15)
16	17	18	19	20	(21)	22
23	24	25	26	(27)	28	29
30	31					

September

S	M	T	W	T	F	S
		1	(2)	3	4	5
6	7	(8)	9	10	11	12
13	(14)	15	16	17	18	19
(20)	21	22	23	24	25	(26)
27	28	29	30			

October

S	M	T	W	T	F	S
				1	(2)	3
4	5	6	7	(8)	9	10
11	12	13	(14)	15	16	17
18	19	(20)	21	22	23	24
25	(26)	27	28	29	30	31

November

S	M	T	W	T	F	S
(1)	2	3	4	5	6	(7)
8	9	10	11	12	(13)	14
15	16	17	18	(19)	20	21
22	23	24	(25)	26	27	28
29	30					

December

S	M	T	W	T	F	S
		(1)	2	3	4	5
6	(7)	8	9	10	11	12
(13)	14	15	16	17	18	(19)
20	21	22	23	24	(25)	26
27	28	29	30	(31)		

Table P.1.1.1
PM10 Sampling Schedule - 1998

P.1.2 ROUTINE SERVICE CHECKS

P.1.2.1 GENERAL INFORMATION

Perform the following service checks according to the attached schedule (Table P.1.2.1), and the procedures documented in this section and in Section P.1.3. Checks may be performed more frequently but should be performed at least at the prescribed intervals. Also attached is a copy of the Monthly Quality Control Maintenance Checksheet (Figure P.1.2.1) which you should complete for each run and forward monthly to your supervisor or designated staff member.

P.1.2.2 EACH RUN

1. Faceplate Gasket - At the end of each run, inspect the faceplate gasket to see if it has lost resilience and become deformed or flattened. The resulting air leakage shows as an irregular edge of particulate deposit on the filter - when the condition is noticed, replace the gasket.

2. Recorder Operation - During the initial flow meter check, observe the flow recorder. If the pen does not move freely, determine the cause. The electric chart drive is permanently lubricated and requires no periodic maintenance. Replace the recorder if it is erratic or inoperative. Recalibrate the sampler after replacing the recorder. If the pen is dry, place a small amount of ink in the hole by the pen tip; if it is a cartridge type, precisely replace the pen. Unless the replacement pen is positioned exactly as the old one, recalibration will be required. After inking or pen replacement, turn on the sampler briefly to verify that the recorder is inking and zeroing properly.

3. Flow Meter Tubing - On all samplers inspect the tubing for deterioration or cracks. Replace if necessary.

P.1.2.3 EACH 30 DAYS

A fixed orifice check should be run every 30 days. Run the sampler until it is adequately warmed up, approximately 15 minutes. Install a clean filter and place the fixed orifice over the filter and tighten it down. Turn on the sampler and allow the Dickson Chart trace to stabilize for 5 minutes. Convert the manometer pressure drop reading to true flow and record the flow and pressure readings on the monthly checksheet. If the fixed orifice reading is more than $\pm$ 5% from the reading taken after calibration with respect to the Dickson reading, request a recalibration.

P.1.2.4 800 HOUR CHECKS

1. Sampler Motor Brushes - The electric motor of the sampler uses a pair of carbon brushes which wear during sampler operation and periodically must be replaced. Do this on a regular basis rather than wait until brushes wear down and excessive pitting and arcing occurs or the motor stops. Change the brushes every 800 hours (48,000 minutes) of operation, or sooner if necessary. All samplers must be equipped with an elapsed time meter. Record the date the brushes are changed and the elapsed time meter reading on the Monthly Checksheet Recalibrate after changing brushes, noting the following precaution:

   a. Calibrating and sampling should only be performed after a break in period of 2 hours to properly seat the brushes against the armature. This period requires running the sampler against a resistance equivalent to a clean filter or a number 18 calibration plate.

   b. When replacing brushes, pull at the center motor shaft to check for excessive play. If shaft play exceeds 1/8" in any one direction replace the motor.

2. Armature - Once the armature becomes worn, the brush life drops considerably, to 300 hours or less. When opening the motor housing to change the brushes, inspect the armature. Replace the motor if the armature has excessive wear, such as deep grooving on the commutator or lack of segmentation. Recalibrate.

3. Motor Wiring - Inspect motor windings for any abnormalities such as burnt wires. Clean dust from motor. If motor is inoperative or unable to give a flow rate (with two clean filters in place) of at least the value listed in Table P.2.0.1, troubleshoot the system (motor, flow controller, line voltage) and correct as required.

4. Motor Gaskets - Inspect top and bottom gaskets for wear and deterioration and replace if necessary. Twisted power leads indicate that motor gaskets are not holding motor firmly and gaskets need to be replaced.

5. Timer Calibration - Check upon installation and every 800 hours against an elapsed time meter. If not within $\pm$15 minutes/24 hours, adjust and repeat test on next scheduled run.

6. Elapsed Time Meter - Check upon installation and every 800 hours against a standard timepiece of known accuracy, such as a standard electric clock connected during a scheduled run. If not within ±2 minutes/24 hours, adjust or replace.

7. Recalibration - Conduct a flow rate calibration at 800 hour intervals or after any motor maintenance is done such as replacement of brushes, repair or replacement of motor or flow rate measuring device (rotameter or recorder). Also calibrate if the initial flow meter reading falls outside the average initial flow meter reading tolerance limits shown on the Monthly Checksheet. After replacement of brushes (except for 800 hour maintenance interval), repair or replacement of motor or the rate measuring device (recorder), run a single point fixed orifice check. If the value varies from the previous monthly reading by more than ± 10%, recalibrate the sampler. Conduct the calibration according to the standard procedure in this Manual, Appendix P.2. Note the break in period when motor maintenance is performed (see 1.a above).

8. Check power cords for deterioration and replace if necessary.

P.1.2.5 INLET INSPECTION AND CLEANING

The size selective inlet must be inspected and cleaned at intervals dependent on local average total suspended particulate (TSP) concentrations. Your supervisor will provide you with the cleaning frequency required for a 6-day sampling schedule at your specific site.

1. Remove the hood; clean the nine acceleration nozzles with a bottle brush; wipe the surfaces clean with a damp cloth and reassemble.

2. Release the four hook catches on the side of the inlet and raise the upper half of the inlet.

3. Carefully remove the greased shim and clean on a flat surface using a clean cloth or Kimwipe. If necessary, use a small vacuum cleaner to remove dirt. Isopropyl alcohol or acetone may be used to aid in cleaning. After the shim is clean and dry, generously coat the shim evenly with Dow Silicone #316, holding the spray can containing the silicone mixture 8 to 10 inches from the surface of the shim.

4. Remove the vent tube plate and clean the tubes with a bottle brush and wipe the external surfaces with a clean rag or Kimwipe.

5. Remove the bug screen and wipe with a clean rag. Inspect to make sure no lint remains on the screen.

6. Wipe the interior of the inlet with a clean cloth.

7. Inspect the joint seals and screw holes where the acceleration nozzles are attached to the acceleration nozzle plates and where the vent tubes are attached to the impaction plate. If the seals are damaged, replace them.

8. Reassemble inlet, making sure that the greased shim is held down by the two shim clips.

9. If necessary, adjust the four hook catches to slightly and evenly compress the sealing gasket when the inlet is closed.

10. Reassemble the hood onto the housing with screws and spacers.

11. Document the cleaning date on the Monthly Quality Control Maintenance Checksheet (see Figure P.1.2.1).

CALIFORNIA AIR RESOURCES BOARD
MONTHLY QUALITY CONTROL MAINTENANCE CHECKSHEET
PM10

LOCATION: Modesto
STATION NUMBER: 50-567
SAMPLER PROPERTY NUMBER: 07332

MONTH YEAR: Dec/1990
TECHNICIAN: D.Arnold
AGENCY: CARB

SAMPLER MAKE & MODEL: SIERRA ANDERSON 1200

Date	1	7	13	14	21*	25	28*
Average IND Flow Average STD Flow	35.3 38.6	36.0 39.5	34.5 37.6	36.0 39.5	34.5 37.6	33.5 38.9	36.0 39.5
Initial Elapsed Time Meter Reading	32825	34261	35700	37138	38577	41453	42892
Final Elapsed Time Meter Reading	34261	35700	37138	38577	41453	42892	44331
Average STD Flow Tolerance Limits, +/-5%	38.0 to 42.0						

OPERATOR INSTRUCTIONS:

1. Each Run: Check and record initial flow meter reading, inspect faceplate gasket, verify flow recorder operation, record initial and final elapsed time meter readings.
2. 30 Day Interval: Fixed Orifice Check Date performed 12/17/90 DP 4.0 "H20. True Flow 39.6 SCFM. Ind Flow 36.0
3. Interval as required: Clean sampler. Date last cleaned: 8/25/90.
4. 800 Hour Intervals: Replace sampler motor brushes and inspect armature, motor shaft, motor gaskets, motor wiring, and flow meter tubing. Date brushes replaced: 10/17/90. Elapsed time meter reading: 21651 . Calibrate sampler. Date last calibrated 11/16/90 Linear Regression Equation 1.258(IND)-5.78 . Elapsed time meter reading: 78358 .

Date	Comments or Maintenance Performed
19	Corner of Filter Torn. Sample Invalidated. *Make up 21st.
21	Elapsed Time, Double. Sample Invalidated. *Make up 28th

Reviewed By: Ges Date: 1/91

Figure P.1.2.1
Monthly Quality Control Maintenance Checksheet

Table P.1.2.1
PM10 Sampler Service Schedule

	EACH RUN	EACH 30 DAYS	800 HOUR INTERVAL
INSPECT FACEPLATE GASKET	X		
CHECK OPERATION OF FLOW RECORDER	X		
CHECK FLOW RECORDER INKING	X		
INSPECT FLOW METER TUBING		X	
FIXED ORIFICE CHECK			X
REPLACE MOTOR BRUSHES			X
INSPECT ARMATURE			X
INSPECT MOTOR WIRING			X
INSPECT MOTOR GASKETS			X
CHECK TIMER CALIBRATION			X
CHECK ELAPSED TIME METER			X
CHECK POWER CORDS			X
REPLACE MOTOR	AS REQUIRED		
CLEAN INLET AND GREASED SHIM	AS REQUIRED (SEE TABLE P.1.2.2)		

P.1.3 DETAILED MAINTENANCE PROCEDURES

P.1.3.1 REPLACING CARBON BRUSHES

1. Unplug the main power cord from the timer. Unplug the flowmeter tubing. Remove motor from PM10 shelter.

2. Remove the nuts on the locking clamp which secures the cylindrical motor housing to the sampler head (or unscrew the adapter mounting plate in some designs).

3. Remove the top rubber gasket. Put it aside.

4. Loosen nut on power cord where cord enters the motor housing.

5. Remove the motor from the housing.

6. Disconnect flat electrical connector from each brush by sliding it out toward the armature using a screwdriver.

7. Remove screws from clamps securing both brush holders. Remove the old brushes and discard.

8. Install the new brushes so that the slot in the base of the brush holder seats on the metal base peg. Tighten screws on brush holder clamps.

9. Slide the flat electrical connector into each brush holder - the reverse of step 6 above.

10. Dust off both gaskets with a clean cloth. Replace if the foam (motor gasket) or rubber is deteriorated.

11. Reassemble the motor into its cylindrical housing and assemble to the mating, sampler head - the reverse of steps 2 and 5 above.

12. Placement of wire in plenum: Keep wire length as short as possible; twist wire and place as near to side of plenum as possible.

13. Install the motor in the PM10 shelter. Connect the power cord and flowmeter tubing. Run in new brushes (see Section P.1.2.4).

14. Check with a fixed orifice and recalibrate if $\geq$ 10% change in P.

P.1.3.2 REPLACING SAMPLER MOTOR

Follow steps 1 to 5 and 10 to 13 in Section P.1.3.1 of this Appendix.

STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURES

FOR

AIR QUALITY MONITORING

APPENDIX P.2

CALIBRATION PROCEDURES
FOR
SIERRA-ANDERSEN 1200
SIZE SELECTIVE INLET PM10 SAMPLER

MONITORING AND LABORATORY DIVISION

MAY 1991

P.2.0 OVERVIEW

The PM10 sampler is calibrated using an orifice transfer standard that has been standardized against a primary standard Roots meter. The orifice transfer standard is referenced to 25 C and 760 mmHg. Two different types of orifice calibrators are available. One type uses multi-hole adapter plates to vary the flow. The second type has an adjustable flow restrictor. In either case, the calibrator is connected to a differential pressure gauge or slack tube manometer. Pressure drops and indicated flow meter readings are recorded and corrected for elevation as necessary. Using the pressure drops, the standard (true) flow rates are calculated using the certification equation for the transfer standard. Finally, a working sampler calibration curve of standard flow rate vs. indicated flow rate is plotted. The field calibration procedure assumes that:

1. Elevations below 1,000 feet are equivalent to standard conditions.

2. The effect of temperature on the indicated flow rate is negligible and therefore is not used in the determination of the standard flow rate.

P.2.0.1 APPARATUS

1. Orifice Calibrator Transfer Standard with certification equation.

2. 0-10" differential pressure gauge or slack tube manometer.

3. Tygon tubing for static pressure connections.

4. Faceplate adapter with "C" clamps.

5. Flow charts for continuous recorder.

6. Calibration report forms.

7. Plastic cap for constant volume sampler sensor.

P.2.0.2 AS-IS CALIBRATION

Other than routine daily checks, sampler repairs or adjustments (brush changes, motor replacement, flow recorder changes, etc.) should not be made prior to the as-is calibration. The sampler should be calibrated after each 800 hours of operation, if the

sampler is moved to a different site, or if the initial flow meter reading falls outside of specified tolerance limits (shown on the Monthly Checksheet, see Figure P.1.2.1).

NOTE: The samplers use a closed loop control system to provide constant blower speed and sample flow. The flow sensor is located in the throat of the filter holder assembly. Before calibrating the sampler, first disable the controller by disconnecting power to it and connecting the motor directly to the AC power source. After calibrating, return the sampler to its normal operating configuration.

1. Open the PM10 sampler shelter and remove the filter holder. Secure the faceplate adaptor and orifice calibrator; then, tighten down the orifice calibrator. If using a variable resistance calibrator, simply secure the calibrator to the faceplate adaptor and turn the restrictor control fully counter-clockwise so that the maximum flow will be obtained.

2. Perform a leak check as follows:

    a. Disconnect the tubing from the side port of the orifice.

    b. Tape closed the hole(s) on top of the orifice and the side port so that the orifice is sealed.

    c. Put a clean chart in the Dickson recorder and zero the recorder.

    d. Turn the motor on and observe the Dickson recorder. There should be no upscale movement of the pen. If there is movement of the pen, correct the leak if it is at the orifice or its attachment to the filter holder housing. If the leak is below the filter holder, perform an as-is calibration before correcting the leak.

3. Remove the tape from the orifice and connect a section of Tygon tubing from the orifice tap on the calibrator to one leg of a manometer (or to a differential pressure gauge). Open the other leg so that it is open to the atmosphere. A schematic diagram of a typical sampler flow calibration is shown in Figure P.2.0.1.

4. After the sampler has warmed up, turn the motor off and then on and allow the as-is static pressure (ΔP) and indicated flow reading (Qind as-is) to

stabilize. Tap the recorder with your finger and using a coin or screwdriver, advance the recorder chart to obtain a flat trace of at least ½ inch. Then, read the as-is static pressure (ΔP) and indicated flow reading (Qind as-is). Record these values on the Calibration Datasheet (see Figure P.2.0.3). The as-is static pressure is read as the total displacement, in inches, of the manometer water column or differential pressure gauge reading. Next, calculate Qstd as-is using the value of ΔP as-is measured above and the certification equation (ref: step 9 that follows) and record it on the Calibration Datasheet.

5. Repeat step 4 for each of the remaining four load plates. When using the variable resistance calibrator, select 40 SCFM and four additional points equally spaced around 40 SCFM (two points above and two points below; see example in Figure P.2.0.3). Perform a total of three test runs.

6. Remove the orifice calibrator from the sampler. Measure the indicated flow with a clean filter installed in the PM10 sampler and record this value on the bottom of the Calibration Datasheet. If an electronic flow controller is used, perform steps (7) through (10), then adjust the flow controller to 40 actual CFM set point with the clean filter installed. The acceptable initial flow meter range is 40 actual CFM $\pm$ 5 percent (at sites $\geq$ 1,000 feet elevation, the set point is 40 CFM x altitude correction factor). Refer to Table P.2.0.1.

7. On the left side of the Calibration Datasheet, sum the ΔP readings for each line (Runs 1-3) and record the sum under column heading "SUM ΔP"; then calculate and record the average ΔP for each line (Points 1-5). On the right side of the data sheet, sum the Qind readings for each line (Runs 1-3) and record the sum under the column heading "SUM Qind"; then calculate and record the average Qind for each line (Points 1-5).

8. Record the elevation of the sampler on the Calibration Datasheet. If the elevation is less than 1,000 feet, proceed to P.2.0.2, step No.9 (on the following page), as no altitude correction is required. If the elevation is 1,000 feet or greater, apply the altitude correction factor as follows:

    a. Using Table P.2.0.1, find the appropriate correction factor corresponding to the elevation of the sampler, or calculate the factor using the equation given in the Calibration Datasheet.

    b. Record the altitude correction factor on the Calibration Datasheet.

c. Multiply the average ΔP's on the left side of the Calibration Datasheet by the altitude correction factor, and record these values under "CORR ΔP".

9. Referring to the certification equation and using the corrected ΔP values calculated in 8.c above (or average ΔP values for locations less than 1,000 feet elevation), determine and record Qstd (transfer standard) for each point, where:

$$Qstd = Factor\sqrt{CORR\Delta P}$$

10. Using the data from the Calibration Data Sheet, plot a Calibration Graph Qstd (transfer standard) vs. Qind. Draw a straight line through the plotted points, or, if facilities are available, obtain a linear regression computer plot.

    This line represents the working sampler calibration graph for the particular sampler elevation. A sample plot is shown in Figure P.2.0.4.

11. Using the value of Qind as-is from step 4, determine Qprev by referring to the previous sampler calibration curve (Qstd vs. Qind). Find the appropriate value of Qprev from the y-axis corresponding to Qind on the x-axis. Record Qprev on the Calibration Datasheet.

12. Calculate the percent deviation from previous calibration using the equation listed on the bottom of the Calibration Datasheet. Record the result.

13. Using the sampler calibration graph, convert the clean filter indicated air flow rate to standard air flow rate and record the result on the bottom of the Calibration Datasheet.

14. Complete a Calibration Report (see Figure P.2.0.2). Send in to the instrument files. Return a copy to the sampling site for inclusion in the station file.

P.2.0.3 FINAL CALIBRATION

A final calibration is required after specified maintenance is performed (brush changes, motor replacement, flow recorder changes) or to repeat a sampler calibration graph which is non-linear. Repeat the calibration beginning with Section P.2.0.2, step 1.

P.2.0.4 BLANK FORMS AND ASSISTANCE

A supply of blank Calibration Data Sheets can be obtained by contacting:

STATE OF CALIFORNIA
Air Resources Board
Monitoring and Laboratory Division
Instrumentation and Operations Support Section
P.O. Box 2815
Sacramento, CA 95812

Telephone (916) 445-0616

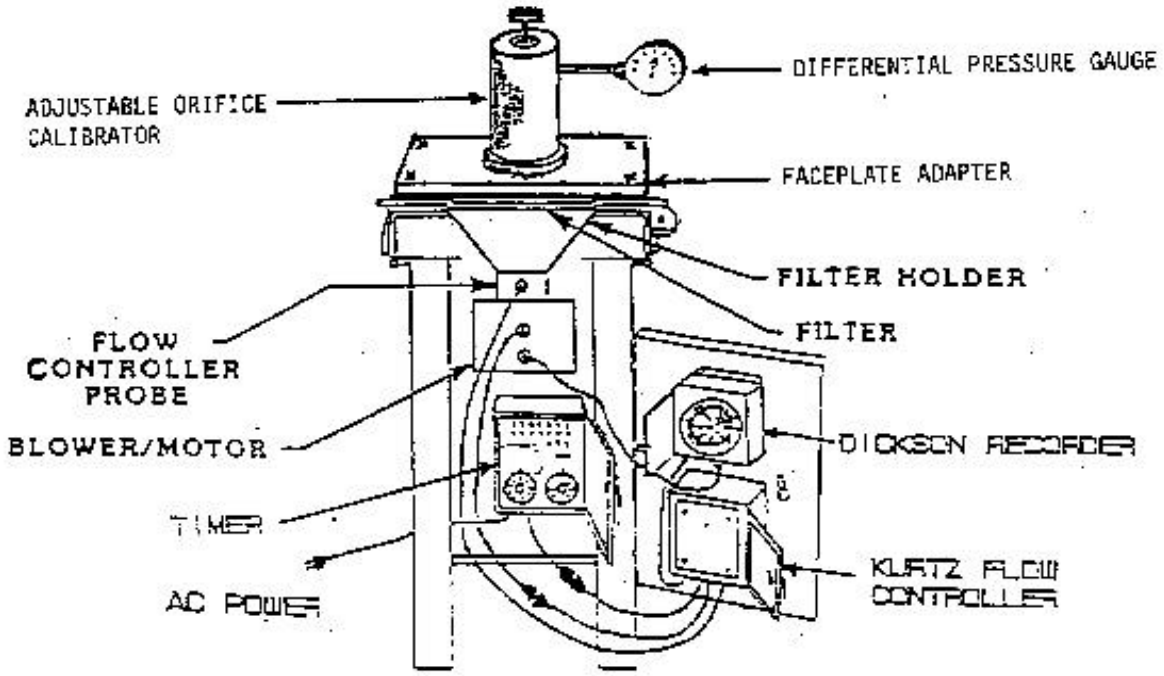


Figure P.2.0.1

PM10 Sampler Flow Calibration

CALIFORNIA AIR RESOURCES BOARD
CALIBRATION REPORT

TO: Don Castles
Yolo-Solano APCD

FROM: Gerhard Achtelik
Monitoring & Laboratory Division

LOG NUMBER: 90 193
CALIBRATION DATE: 12-7-90
REPORT DATE: 12-18-90

IDENTIFICATION

Instrument General Metal Works	Site Name Standards Lab
Model Number	Site Number 34-299
Property Number L0015	Site 1309 T Street
Serial Number	Location Sacramento
Previous Calibration Log Number SL-872	Elevation
Instrument Property of: Yolo-Solano APCD	

CALIBRATION STANDARDS

Standard	I.D. Number
Roots Meter	4488

CALIBRATION RESULTS

Component	SCFM	CFM	SCFM	CFM
Instrument Range	0 to 60	60		
Display	"H20	"H20		
Best Fit Linear Regression : (X = Guest Inst. Y = True Flow: Slope	17.71	28.28		
Previous Calibration Date	10-12-89	10-12-89		
Change from Previous Calibration, %	0.0	0.04		

Certification Equations: Certifications Expire: 12-6-91

Airflow (SCFM) = 17.7 $\sqrt{\Delta P}$

Airflow (CFM) = 28.3 $\sqrt{\Delta P \times T_a / P_a}$ where $T_a = {}^{o}K$ and P_a = mm Hg

Calibrated By GA

Checked By g achtelik

MLD-25E (5-91)

Figure P.2.0.2
Calibration Report

CALIFORNIA AIR RESOURCES BOARD
PM10/HIGH VOLUME SAMPLER CALIBRATION DATA SHEET

DATE 11-16-90 CALIBRATION: AS-IS [ ] FINAL [X]

LOG NUMBER INSTRUMENT: HI-VOL [ ] SSI [X] FOR SSI ONLY: HEAD OUT POINT 9.54

ORIFICE CALIBRATOR TRANSFER STANDARD	SAMPLER BEING CALIBRATED
Make and Model: BGI	Make and Model: SIERRA ANDERSEN/ETM: 78358
Property Number: 0509	Property Number: 7332 Altitude of Operation 1200 <1000
Altitude Correction Factor*: 1 (≤1)	Property of ARB Date Last Calibrated 4/24/90
Certification Equa: Std. Airflow = 22.9 √CORR ΔP (Factor)	Location: MODESTO-Coffee Station No: 50-567

STATIC PRESSURE ΔP "H2O RUN 1	RUN 2	RUN 3	SUM ΔP "H2O	AVG ΔP "H2O	CORR ΔP "H2O	2 Qstd SCFM		INDICATED FLOW Qind RUN 1	RUN 2	RUN 3	SUM Qind	AVG Qind
4.60	4.60	4.60	13.8	4.60		49.1	POINT 1	43.5	43.5	43.0	130.0	43.3
3.86	3.86	3.86	11.58	3.86		45.0	POINT 2	40.5	41.0	40.5	122.0	40.7
3.05	3.05	3.05	9.15	3.05		40.0	POINT 3	36.5	36.5	36.5	109.5	36.5
2.34	2.34	2.34	7.02	2.34		35.0	POINT 4	33.0	32.5	32.5	97.5	32.5
1.72	1.72	1.72	5.16	1.72		30.0	POINT 5	29.0	28.0	28.0	85.0	28.3

"As-is" checks: ΔP as-is= 2.8 ". Qind as-is= 33.7 CFM. Qstd as-is= 38.3 SCFM. Qprev= 39.4 SCFM.

Previous Calibration Date 4/24/90 Previous Linear Regression Equation 1.24 (IND) − 2.4

% Deviation from Previous Calibration = $\frac{\text{Qstd as-is} - \text{Qprev}}{\text{Qprev}} \times 100\% = \frac{38.3 - 39.4}{39.4} \times 100\% = -2.8\%$

1. Corrected ΔP = Average ΔP x Altitude Correction Factor.
2. Qstd (transfer standard) is obtained from the certification equation listed above.
3. Qprev is obtained from the last sampler calibration curve (Qstd vs. Qind).

Hi-Vol: Clean filter: Indicated Flowrate = _____ ; Standard Flowrate = _____ SCFM (Set to 45 SLPM).

SSI: Clean Filter: Indicated Flowrate = 36.5; Standard Flowrate = 40.0 SCFM = 40.0 Actual CFM (Set to 40 Actual CFM).

NEW LINEAR REGRESSION EQUATION 1.258 (IND) − 5.78

For SSI Only: Actual CFM = SCFM/Altitude Correction Factor.

COMMENTS: _____

Calibrated by BE Checked Geo

* Alt. Cor. Fac. = 1.001 x exp (-.0000371 x Altitude, feet) if Altitude > 1000 feet; otherwise = 1.000 (Note: Alt.Cor. Fac. ≤ 1.).

Figure P.2.0.3
PM10 Sampler Calibration Datasheet

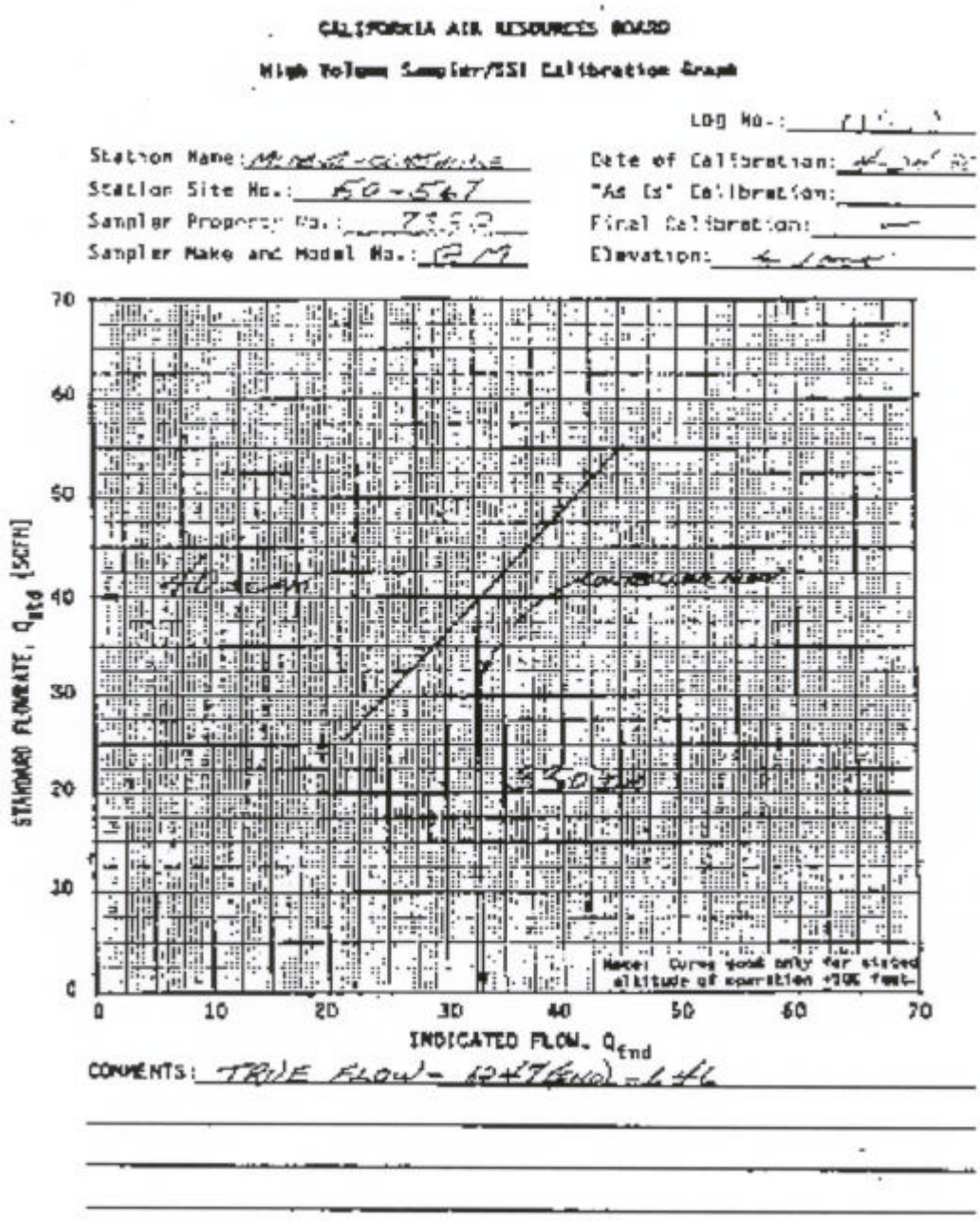


Figure P.2.0.4
PM10 Sampler Calibration Graph

Table P.2.0.1
Elevation vs. Altitude Correction Factor and Standard Flow Rate

Elevation (Feet Above Sea Level)	Altitude Correction Factor	Flow Rate Set point (SCFM)
0-999	1.000	40.0
1000	.965	38.6
1250	.956	38.2
1500	.947	37.9
1750	.938	37.5
2000	.930	37.2
2250	.921	36.8
2500	.913	36.5
2750	.904	36.2
3000	.896	35.8
3250	.888	35.5
3500	.879	35.2
3750	.871	34.8
4000	.863	34.5
4250	.855	34.2
4500	.847	33.9
4750	.840	33.6
5000	.832	33.3
5250	.824	33.0
5500	.817	32.7
5750	.809	32.4
6000	.802	32.1
6250	.794	31.8
6500	.787	31.5
6750	.780	31.2
7000	.772	30.9
7250	.765	30.6
7500	.758	30.3
7750	.751	30.0
8000	.744	29.8
8250	.737	29.5
8500	.731	29.2

STATE OF CALIFORNIA

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AIR QUALITY MONITORING

APPENDIX P.3

VOLUMETRIC FLOW CONTROLLER
FOR
SIERRA-ANDERSEN 1200
SIZE SELECTIVE INLET PM10 SAMPLER

MONITORING AND LABORATORY DIVISION

MARCH 1996

P.3.0 CALIBRATION PROCEDURES

This document describes the calibration procedure for the PM10 Volumetric Flow Controller (VFC) system. The VFC uses a vacuum cleaner motor that operates at maximum speed. The vacuum motor draws air through a fixed area in the VFC, and a critical flow is established through the PM10 sampling head at 40 cubic feet per minute (CFM). Since the VFC's performance varies with ambient temperature and pressure, each VFC has a set of NIST traceable factory calibration tables for temperature in degrees C and F. For the sake of simplicity and with minimum error ($\pm$ 2.5 percent), all of the VFC calibration curves have been averaged to produce an average slope and intercept. The average slope and intercept will be used for the calibration and operation of the volumetric flow controller used in PM10 samplers. The VFC does not contain moving parts, so there is no way to adjust the flow. The VFC's calibration will not change if the orifice is clean and the motor is able to operate at maximum speed. The following calibration procedure describes a "Single Point Calibration Verification" (SPCV). An illustration of the Sierra - Andersen/GMW PM10 sampler with a VFC is presented in Figure P.3.0.1. The EPA reference method designation for the Sierra Andersen 1200 PM10 sampler with a VFC is RFPS-1287-063. This document does not replace Appendix P of Volume II of the Air Monitoring Quality Assurance Manual. It is intended to supplement Appendix P for the operation, calibration and maintenance of the VFC PM10 sampler.

P.3.0.1 CALIBRATION VERIFICATION MATERIALS

1. A certified BGI flow transfer standard (variable orifice).
2. A clean quartz fiber filter.
3. A PM10 sampler with an internally mounted 0 to 40 inches water Magnehelic.
4. A portable standard temperature thermometer and a portable standard pressure transducer.
5. Calculator or lap-top computer.
6. Dickson recorder charts.
7. VFC Calibration Data Sheets (MLD-38a) or calibration form in computer format.
8. Stagnation tap quick-connect fitting and Tygon tubing.

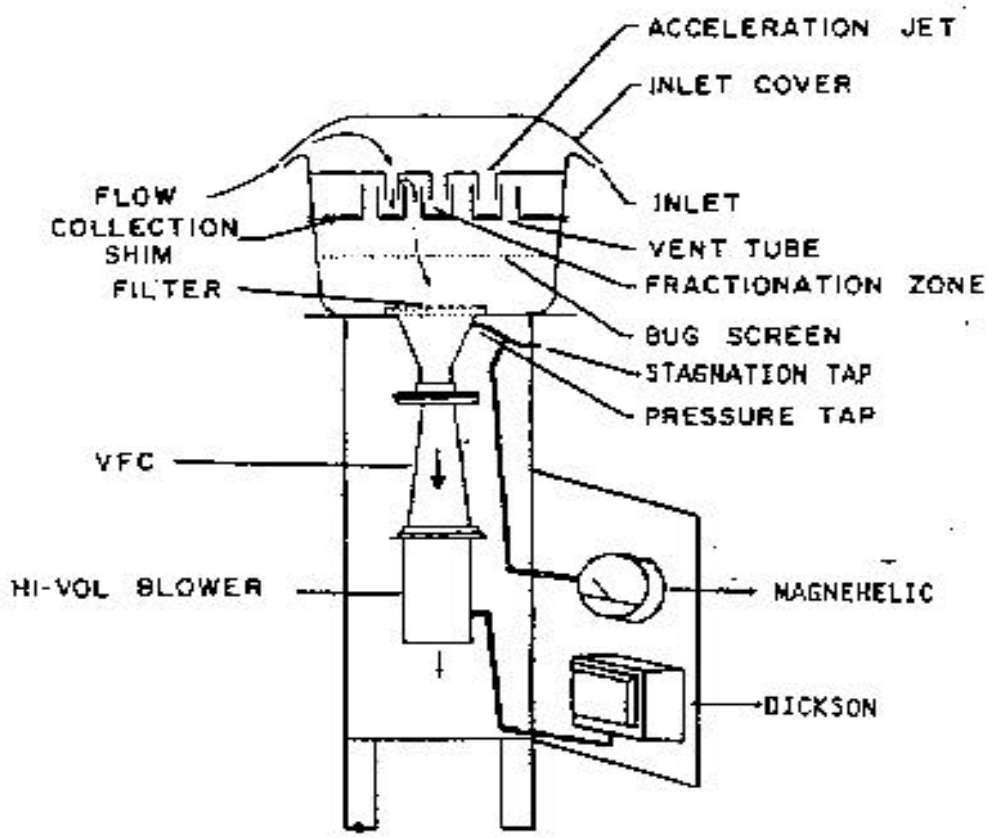

Figure P.3.0.1
Diagram of the Sierra-Andersen/GMW Model 1200 with VFC

P.3.0.2 AS-IS CALIBRATION

1. Plug in the temperature and pressure standard, turn it on and let it warm up for at least ½ hour. Fill out the Volumetric Flow Control PM10 Calibration Datasheet (Figure P.3.0.2), as much as possible, before starting the calibration. Be sure to record the date, location, site number, and the pertinent calibration standards information. Also, record the sampler make and model, VFC serial number, and property number, etc., on the VFC Calibration Datasheet. Refer to the VFC Calibration Sheet Instructions in Figure P.3.0.3.

2. Measure the ambient temperature (Ta) with a thermometer that has a calibration traceable to the National Institute of Standards Technology (NIST). Record the thermometer's display value on the VFC Calibration Datasheet.

3. Measure the ambient absolute pressure (Pa) with a capacitance manometer pressure transducer that has a calibration traceable to the NIST. Record the manometer's display value on the VFC Calibration Datasheet.

4. Place a new circular chart on the Dickson Chart Recorder. Install a clean quartz fiber filter in the filter holder. Connect the capacitance manometer to the pressure tap at the top of the VFC. It has been plumbed to make it accessible, via a quick-connect fitting, on the side of the PM10 sampler. See Figure P.3.0.1. Turn on the sampler and let it run for 5 minutes to warm-up the motor. Read the initial absolute pressure across the clean filter (aPf) using the capacitance manometer. Record the value of the capacitance manometer display in the box labeled "Initial Clean Filter Absolute Pressure" in mmHg. Gently tap on the side of the Dickson recorder, and spin the chart about 7 degrees of arc. Read and record the indicated Dickson reading on the VFC Calibration Datasheet.

5. Turn off the sampler, remove the filter, and install the BGI variable orifice. Turn on the sampler and adjust the variable orifice until the pressure drop, as measured by the capacitance manometer, matches the reading when the filter was installed. Read the differential pressure on the BGI variable orifice Magnehelic, and record it in the box labeled "BGI Magnehelic Pg "H_20" on the VFC Calibration Datasheet.

6. Calculate the true flowrate (Qt) based on the BGI's certification values for the single point flow verification as shown below and record the flowrate in the box marked "Qt CFM" on the data sheet.

Qt = C x Square root[Pg BGI x (Ta/Pa)]
Qt = True Volumetric flow rate, cubic feet/minute (CFM).
Ta = Measured ambient absolute temperature in degrees K.
Pa = Measured true ambient absolute pressure in mmHg.
Pg BGI = The pressure drop measured by the variable orifice.
C = Certification coefficient for volumetric flow.

7. Again, with a capacitance manometer reading that matches the initial clean filter absolute pressure (record this value in the box marked "P/T Std Abs Pres mmHg"), read the sampler Magnehelic pressure gauge reading. Record the value on the Calibration Datasheet in the box labeled "Magnehelic Pf "H20" Turn the sampler off.

   Calculate the sampler volumetric flow. The first step requires the absolute pressure ratio, Po/Pa. Determine Po/Pa by the following ratio:

   Po/Pa
   where:
   Po = absolute pressure measured across the clean filter in mmHg (same as aPf).
   Pa = ambient absolute pressure in mmHg.

8. Record the value for Po/Pa in the box labeled "Po/Pa". Next, calculate the sampler's volumetric flow rate (Qv) using the VFC slope and intercept and the ambient temperature. The average VFC slope is 45.379, and the intercept is -2.243. This slope and intercept has been derived from 40 Graseby-Andersen VFCs received by the ARB in April 1993. This relationship may not hold outside of the 40 VFC's tested by the ARB (Shahinian, 1993).

   In addition, the flow rate in CFM must be adjusted for temperature. The slope and intercept derived above were calculated at 77 degrees Fahrenheit (Qv °f) or 25 degrees Centigrade (Qv °c). The correction factor is ±0.033 CFM per degree Fahrenheit, or ±0.059 CFM per degree Centigrade. For temperatures below standard temperature (25 degrees C) the correction will be negative. For temperatures above standard temperature (25 degrees C) the correction will be positive. A complete set of equations to determine flow in CFM for degrees F and for degrees C is presented below, including the slope and intercept:

$Qv\,°f = [(45.379 \times (Po/Pa)) - 2.243] + [(Tf - 77) \times 0.033]$

or

$Qv\,°c = [(45.379 \times (Po/Pa)) - 2.243] + [(Tc - 25) \times 0.059]$

Record the flowrate as calculated using one of the above equations in the box labeled "Qv CFM" on the data sheet.

9. The BGI transfer standard flow rate (Qt CFM) is considered the "true" flowrate. Compute the Percent Difference from True using the following calculation:

$$\text{Percent Diff from True} = \frac{|Qv - Qt|}{|\ Qt\ |} \times 100 = \_\_\_\_\_\%$$

Record the percentage in the box marked "Percent Diff. from True" on the VFC Calibration Datasheet. If the difference is greater than $\pm$5 percent, perform a system leak check, inspect the VFC for debris or corrosion, and inspect the motor's brushes. Contact the instrumentation shop staff, or replace the VFC if the problem persists.

10. Calculate the Percent Difference from Previous Calibration using the following equation:

$$\%\ \text{Difference from Previous Calibration} = \frac{Qt - Qt\ prev}{Qt\ prev} \times 100 = \_\_\_\_\_\%$$

Record the Percent Difference from Previous Calibration on the VFC Calibration Datasheet.

11. With the sampler off, read and record the zero (0) point on the 0 - 40 inch Magnehelic gauge. Record this information on the calibration data sheet in the cell marked "Sampler Magnehelic Zero". If the zero (0) is not on zero, it needs to be adjusted to zero, and a final calibration must be performed.

12. Perform a comparison to verify the accuracy of the sampler's Magnehelic gauge. Use the data collected in the boxes labeled "P/T Std Abs Pres mmHg" and "Magnhelc Pf "H20". The Magnehelic percent accuracy must be within $\pm$5 percent. If the gauge is outside this limit it must be replaced.

The following formula describes this calculation:

$$\text{Magnehelic Percent Accuracy} = \left| \frac{(Pf_m \times 1.867) - (Pa - Pf_{p/t})}{(Pa - Pf_{p/t})} \right| \times 100$$

where: Pa = ambient pressure in mmHg
$Pf_{p/t}$ = absolute pressure across clean filter measured by capacitance manometer (same as "P/T Std Abs Pres mmHg" on data sheet)
Pf_m = pressure drop across the filter measured by the Magnehelic (same as "Magnhelc Pf "H2O" on datasheet)

13. Complete the VFC Calibration Data Sheet (MLD-38a, Figure P.3.0.2), and the Standard Instrument Calibration Report (MLD- 25, Figure P.3.0.4). Place the completed calibration report package in the instrument files. Return a copy to the sampling site for inclusion in the station file.

P.3.0.3 FINAL CALIBRATION

A final calibration is required after specified maintenance is performed (i.e., flow recorder change, 0-40 inch Magnehelic adjustment, VFC cleaning, VFC replacement, moving the sampler etc.). A final calibration is not needed for brush changes, unless the fixed orifice test indicates that the flow has changed by more than 2 percent. A final calibration can be performed by repeating the VFC as-is calibration procedure beginning with Section P.3.0.2.

REFERENCE: George Shahinian, Volumetric Flow Calibration, Informal Memo to Michael Spears, May 14, 1993.

CALIFORNIA AIR RESOURCES BOARD
VOLUMETRIC FLOW CONTROL PM10 CALIBRATION DATASHEET

DATE_____ CALIBRATION: AS-IS|___| FINAL |___|

Site Name:	Site Elevation:
Site Number:	Ambient Temp C: (Ta) 1
Log Number:	Ambient Pres mm Hg: (Pa) 2

CALIBRATION STANDARDS	SAMPLER BEING CALIBRATED
Orifice Std. Make/Model:	Make and Model:
Property Number:	VFC Serial Number:
Date Certified:	Property Number:
Cert Eq:=( )xSqrt(Pg(Ta/Pa))	Last Cal. Date: Flow:
factor	Sampler Magnehelic Zero:
P/T Std. Property Number:	Initial
P/T Date Certified:	Clean Filter Absolute
	Pressure mm Hg: (aPf) 3
	Dickson Chart Reading: 4

SINGLE-POINT CALIBRATION VERIFICATION

Variable Orifice True Volu. Flow (Qt)		Sampler Volumetric Flow (Qv)				
BGI Magnehelic Pg "H_2O	Qt CFM	P/T Std Abs Pres mm Hg	Magnhelc Pf "H_2O	Po/Pa	Qv CFM	Percent Diff. from True (Qt vs. Qv.)
		same as				
5	6	3	7	8	9	10

$$\text{Percent Diff from True} = \frac{|Qv - Qt|}{Qt} \times 100 = \_\_\_\_\_ \%$$

$$\%\ \text{Difference from Previous Calibration} = \frac{Qt - Qt\ prev}{Qt\ prev} \times 100 = \_\_\_\_\_ \%$$

$$\text{Magnehelic Percent Accuracy} = \frac{|(Pf_m \times 1.867) - (Pa - Pf_{p/t})|}{(Pa - Pf_{p/t})_{p/t}} \times 100 = \_\_\_\_\_ \%$$

Pressure in "H_2O can be converted to mm Hg by multiplying by 1.867.
$Qv^{o}f = [(45.379 \times (Po/Pa)) - 2.243] + (Tf - 77) \times 0.033$, or
$Qv^{o}c = [(45.379 \times (Po/Pa)) - 2.243] + (Tc - 25) \times 0.059$

$$Qt = C \times Sqrt[Pg\ BGI \times (Ta/Pa)]$$

Comments:_____

MLD-38a (5-5-95) Calibrated by_____ Checked by_____

Figure P.3.0.2
VFC Calibration Datasheet

VOLUMETRIC HI VOL CALIBRATION SHEET INSTRUCTIONS

(Short Form)

1. Measure ambient temperature and pressure standard.

2. Measure ambient pressure Pa using temperature and pressure standard.

   Install clean filter and new chart. Connect pressure standard to pressure tap on Hi Vol. Turn on Hi Vol for 5 minutes.

3. Read initial absolute pressure across filter aPf from pressure standard.

4. Read Dickson Chart.

   Turn off sampler, remove filter, install orifice. Turn on sampler and adjust orifice until pressure drop as read on pressure standard agrees with measurement in step 3.

5. Read orifice magnehelic BGI Magnehelic Pg "H20.

6. Calculate true flow Qt based on orifice certification values.

   $$Qt = \text{cert value} \sqrt{\text{orifice magnehelic} \times \frac{°Ta}{Pa}}$$

   *Note for Ta use Kelvin°K =°C + 273

7. Read sampler magnehelic Magnehelic Pf "H20

   TURN OFF SAMPLER

8. Calculate Po/Pa which is same as aPf/Pa.

9. Calculate samplers volumetric flow Qv using average VFC slope and intercept values for ARB VFC samplers: slope 45.379 intercept -2.243 formula for degrees C is:

   $$Qv = [(45.379 \times (aPf/Pa))-2.243] + [(Ta - 25)x.059]$$

10. Calculate percent difference between Qv and true flow or Qt.

Figure P.3.0.3
VFC Calibration Sheet Instructions

CALIFORNIA AIR RESOURCES BOARD.0
CALIBRATION REPORT

TO:

LOG NUMBER:
CALIBRATION DATE:
REPORT DATE:

FROM:

IDENTIFICATION

Instrument: Site Name:
Model Number: Site Number:
Property Number: Site:
VFC Serial Number: Location:
Previous Calibration Log Number: Instrument Property of:
Elevation: Site Temperature: °C Barometric Pressure: mmHg

CALIBRATION STANDARDS

Standards	I.D. Number	Certification	Certified Value

CALIBRATION RESULTS

Component	PM10		
Volumetric Flow Rate Qt, (BGI) CFM			
Sampler Flow Rate Qv, (SPCV) CFM			
Percent Diff from True, Qt vs. Qv			
Change from Prev Cal (/ /) %			
0-40 in Magnehelic Ind Press.			
Magnehelic Percent Accuracy			
Dickson Chart Reading			

Comments:
Calibrated By Checked By
MLD-25 (5/95)

Figure P.3.0.4
Calibration Report

P.3.1 OPERATING PROCEDURES

P.3.1.1 GENERAL INFORMATION

1. The PM10 sampler operation will remain the same as described in Appendix P of the Quality Assurance Manual. Pre and post Magnehelic readings, along with the average outside temperature and average ambient pressure, are recorded on the 24-Hour Air Sample Report (MLD-13A, Rev. 4-94, Figure P.3.1.1). The laboratory staff enters this information into the Laboratory Information Management System (LIMS), and the sampler flowrate, particulate matter concentration, and ion concentrations are calculated by LIMS. The equations to determine volumetric and standard flows are presented at the end of this section.

2. The Dickson chart will be used to verify that the sampler ran at a constant flowrate for the 24-hour sampling period. It will indicate whether catastrophic failures have occurred, (such as brushes wearing out, and power outages), and it will provide evidence of leaks during the leak test. The Dickson chart will not be used to determine the sampler flowrate. The Dickson chart should be sent in with the PM10 filter and the 24-Hour Air Sample Report for VFC PM10.

3. The station operator will keep a record of the Dickson chart reading, average filter pressure drop (Magnehelic), average outdoor temperature, average barometric pressure, elapsed time meter readings, monthly fixed orifice checks with a filter, and a monthly leak test on the quick connect fitting. Note any unusual Dickson chart flow excursions. The results will be recorded on the Monthly Quality Control Maintenance Check Sheet (MLD-36vfc, Figure P.3.2.1).

P.3.1.2 PRE-RUN PROCEDURE

1. Fill out the information needed for the 24-Hour Air Sample Report Form (MLD-13A, Rev. 4/94).

2. Install a clean filter.

3. Install a new Dickson chart. Adjust the time on the Dickson Recorder, if necessary.

4. Turn on the sampler, and allow it to run for 5 minutes.

5. Determine the initial differential pressure reading, across the filter, from the 0-40 inches of water Magnehelic mounted on the sampler. Record the result on the 24-Hour Air Sample Report Form in the box marked "Pd(I)".

6. Turn off the sampler.

7. Set the sampler timer. Record the elapsed time meter reading on the 24-Hour Air Sample Report Form for VFC PM10 on the line marked "START", and on the Monthly Quality Control Maintenance Check Sheet (Figure P.3.2.1).

8. Run the sampler as scheduled.

P.3.1.3 POST-RUN PROCEDURE

1. Remove the Dickson Chart. Verify that the sampler operated as expected. Record the average indicated value on the Monthly Quality Control Maintenance Check Sheet.

2. Turn on the sampler. Allow the motor to warm up for approximately 5 minutes. Read the differential pressure on the 0-40 inch water Magnehelic mounted on the sampler. Record the data on the 24-Hour Air Sample Report Form in the box marked "Pd(F)".

3. Turn the sampler off.

4. Read the final elapsed time meter reading. Record the data on the 24-Hour Air Sample Report Form on the line marked "FINISH" elapsed time meter, and the Monthly Quality Control Maintenance Check Sheet.

5. Calculate the average filter pressure drop (Pfa) using the following equation:

$$Pfa = \frac{(Pf\ initial + Pf\ final)}{2}$$

where: Pf initial = initial filter pressure drop
Pf final = final filter pressure drop

The data will be reported on the Monthly Quality Control Maintenance Checksheet under "Avg Filter Pressure Drop".

6. Determine the most accurate average outside temperature for the 24 hour sampling period. This information can be obtained from the following list in preferential descending order: (1) the outside temperature sensor/data logger

system on site, (2) any ARB/MLD site within 25 miles and 500 feet in elevation, (3) the average temperature for the run period as collected in your area from the National Weather Service, or (4) a seasonal average daily temperature for the sampling site. Record this temperature on the 24-Hour Air Sample Report (Figure P.3.1.1) on the line marked "Ta", and the Monthly Quality Control Maintenance Check Sheet in the box marked "Avg Ambient Temp".

7. Determine the most accurate average daily barometric pressure. This information can be obtained from Table P.3.1.1. For air monitoring sites with elevations below 50 feet, use the ambient sea level pressure (760 mmHg). For air monitoring sites with elevations greater than 50 feet and less than 149 feet, use the pressure correction factor for 100 feet. For air monitoring sites with elevations greater than 150 feet and less than 249 feet, use the pressure correction factor that corresponds to 200 feet, etc. The pressure can also be calculated by multiplying the altitude correction factor by 760 mmHg. The pressure must be reported in mmHg for LIMS to perform the sampler flow rate calculation. Enter the pressure value in the box labeled "Ambient Pres mmHg (Pa)" on the VFC Calibration Data Sheet (Figure P.3.0.2). Also, report the barometric pressure value on the Monthly Quality Control Maintenance Check Sheet in the box labeled "Avg Ambient Press".

8. Fill out the remaining data entries on the Monthly Quality Control Maintenance Checksheet.

9. Carefully remove the filter. Send the filter, the Dickson chart, and the completed 24-Hour Air Sample Report Form to the laboratory.

10. The quantitation of the flow through the VFC PM10 Sampler is a two part process. The first part of the calculation requires the determination of the sampler "volumetric flow". The second part requires the determination of the sampler "standard flow". For the size selective inlet in the PM10 sampler to collect valid samples, the PM10 sampler must operate between 36 and 44 cubic feet per minute (CFM). CFM is volumetric flow. Data reported to the state and national data base must be reported in standard cubic feet per minute (SCFM). SCFM is the flow rate referenced to a temperature of 25 degrees centigrade, and a pressure of 760 millimeters of mercury (mmHg).

The calculation to determine volumetric flow for the ARB PM10 samplers is:

$$CFM = [45.379 \times (Po/Pa)) - 2.243] + [(Tc - 25) \times 0.059]$$

where: Po = the ambient pressure minus the pressure drop across the filter,
Pa = the ambient pressure, and
Tc = the temperature in degrees centigrade.

Once the volumetric flow has been calculated for the PM10 sample, its value is used to determine the standard flow with the following relationship:

$$SCFM = CFM \times (Pa/760) \times (298/Ta)$$

where: Pa = the average absolute ambient pressure in mmHg,
Ta = the average absolute ambient temperature in degrees
Kelvin (K). (degrees K = degrees C + 273)

At the present time, the Laboratory Information Management System (LIMS) automatically calculates the volumetric and standard flow rates with the pre and post filter pressure drops, the average ambient temperature, and the average ambient pressure for the samples analyzed at the Engineering and Laboratory Branch (ELB) in Sacramento.

VOLUMETRIC PM10
24-HOUR AIR SAMPLE REPORT
MLD-13A (REV. 4/94)

SAMPLE NO. (FILTER PAPER NO.) ______ LAB NO. ______

STATION NAME ______ ELEVATION ______

STATION ADDRESS ______

REPORTING AGENCY ______

COUNTY ☐☐ SITE ☐☐☐☐☐ AGENCY ☐ PROJECT ☐

INSTRUMENT NO. ☐☐☐☐☐

SAMPLING CONDITIONS ☐

LOCAL CONDITION CODES (ENTER APPROPRIATE CODE IN BOX AT LEFT)
A: NO UNUSUAL CONDITIONS
B: WIND-BLOWN SAND/DUST
C: CONSTRUCTION NEARBY
D: FARMING OPERATION NEARBY
E: FIRE NEARBY
F: SAMPLER MALFUNCTION (Explain Below)
H: RAIN
I: OTHER (Explain in Remarks)

DATE OF LAST CALIBRATION: YEAR ☐☐ MONTH ☐☐ DAY ☐☐

SAMPLE COLLECTION DATA

	DATE			TIME		ELAPSED TIME METER (min.)	FILTER PAPER WEIGHT (GRAMS)
	YEAR	MONTH	DAY	HOURS	MIN.		
FINISH							
START							
INDICATED FLOW RATE						NET:	NET:

AVERAGE IND. FLOW RATE ☐

P(0) ☐ in. P(F) ☐ in. Ta ☐ °C Pa ☐ mmHg

TO BE COMPLETED BY SAMPLER OPERATORS.

☐ Inspection of sampler and filter indicates that sample collected is in compliance with quality control standards for sampling. Filter and Dickson recorder chart enclosed.

☐ Sample does not meet quality control standards for sampling and should be invalidated. Dickson recorder chart and filter enclosed. Make up sample scheduled for ______

Reasons:
___ Filter Contaminated or Damaged
___ Power Outage
___ Other ______
___ High/Low Flowrate
___ Dickson Chart Recorder Problem
___ Erratic Flowrate
___ Timer Problem

OPERATOR ______ PHONE NO. ______

CALIFORNIA AIR RESOURCES BOARD
Monitoring and Laboratory Division
P.O. Box 2815
Sacramento, CA 95812

REMARKS: ______

PRE-ANA. | POST-ANA.

Figure P.3.1.1
VFC Air Sample Report

Table P.3.1.1
Altitude vs. Barometric Pressure

Altitude (feet)	ACF	Pressure mmHg	Altitude (feet)	ACF	Pressure mmHg	Altitude (feet)	ACF	Pressure mmHg
0	1.0010	760	3100	0.8922	678	6200	0.7953	604
100	0.9973	758	3200	0.8889	676	6300	0.7924	602
200	0.9936	755	3300	0.8857	673	6400	0.7894	600
300	0.9899	752	3400	0.8824	671	6500	0.7865	598
400	0.9863	750	3500	0.8791	668	6600	0.7836	596
500	0.9826	747	3600	0.8758	666	6700	0.7807	593
600	0.9790	744	3700	0.8726	663	6800	0.7778	591
700	0.9753	741	3800	0.8694	661	6900	0.7749	589
800	0.9717	739	3900	0.8662	658	7000	0.7721	587
900	0.9681	736	4000	0.8629	656	7100	0.7692	585
1000	0.9645	733	4100	0.8958	653	7200	0.7663	582
1100	0.9610	730	4200	0.8566	651	7300	0.7635	580
1200	0.9574	728	4300	0.8534	649	7400	0.7607	578
1300	0.9539	725	4400	0.8502	646	7500	0.7579	576
1400	0.9503	722	4500	0.8471	644	7600	0.7551	574
1500	0.9468	720	4600	0.8440	641	7800	0.7523	572
1600	0.9433	717	4700	0.8408	639	7900	0.7495	570
1700	0.9398	714	4800	0.8377	637	8000	0.7467	567
1800	0.9363	712	4900	0.8346	634	8100	0.7412	563
1900	0.9329	709	5000	0.8315	632	8200	0.7384	561
2000	0.9294	706	5100	0.8284	630	8300	0.7357	559
2100	0.9260	704	5200	0.8254	627	8400	0.7330	557
2200	0.9225	701	5300	0.8223	625	8500	0.7303	555
2300	0.9191	699	5400	0.8193	623	8600	0.7276	553
2400	0.9157	696	5500	0.8162	620	8700	0.7249	551
2500	0.9123	693	5600	0.8132	618			
2600	0.9090	691	5700	0.8102	616			
2700	0.9056	688	5800	0.8072	613			
2800	0.9022	686	5900	0.8042	611			
2900	0.8889	683	6000	0.8012	609			
3000	0.8956	681	6100	0.7983	607			

P.3.2 ROUTINE SERVICE CHECKS

P.3.2.1 GENERAL INFORMATION

For a complete description of the routine service checks consult with Section P.1. This section provides only the additional information needed to operate a PM10 sampler with the volumetric flow controller.

P.3.2.2 BRUSH BURN-IN

1. Use a PM10 motor housing as a brush burn-in test stand. Insert the motor in the housing upside down, to see the brushes. Elevate the PM10 motor housing, so the air hole is free to draw air from the bottom of the motor housing. Install the new brushes, check the alignment, connect the wires to the Variac, and run the motor up to about 25% of full power. Visually inspect for arcing.

2. If arcing is excessive, reduce the Variac power, and unplug the power cord. Since there is some play in the placement of the brushes, reposition the brushes for a better fit. Run the motor at 25% of full power for about 20 minutes, then at 50% of full power for an additional 40 minutes. At this point, the air gap between the brushes and the commutator will be reduced, and arcing will be minimal.

3. Disconnect the power cord to the motor, and exchange motors before the expected brush life is exceeded. It may be possible to get 700+ hours on the white type brushes issued from the stockroom, with little or no wear on the motor commutator. New brushes are approximately 1 inch long. It is suggested that the brushes not be worn all the way down. At 1/4 inch of brush remaining, it is possible to hit the core of the brush. Having the brush core wear on the commutator will reduce the life of the motor.

4. Inspect VFC pressure tubing for kinks and cracks.

CALIFORNIA AIR RESOURCES BOARD
MONTHLY QUALITY MAINTENANCE CHECKSHEET
FOR THE
VOLUMETRIC FLOW CONTROL PM10

LOCATION:_____ MONTH YEAR:_____
STATION NUMBER:_____ TECHNICIAN:_____
SAMPLER PROPERTY NUMBER:_____ AGENCY:_____
SAMPLER MAKE & MODEL:_____

Date							
Avg. Dickson Chart Read							
Avg. Filter Press Drop							
Avg. Ambient Temp (°C)							
Avg. Ambient Press mmHg							
Initial Elapsed Time Meter Reading							
Final Elapsed Time Meter Reading							
Volumetric Flow Tolerance Limits: +5% 38.0 to 42.0 CFM							

OPERATOR INSTRUCTIONS:

1. Each Run: Check and record the pre and post filter drop readings, inspect faceplate gasket, verify flow recorder operation, record initial and final elapsed time meter readings.
2. 30 Day Interval: Fixed Orifice Check
   Date performed___ Pf___ "H20. True Flow___
   Stagnation Tap Leak Test Results:___
3. Interval as required: Clean Sampler. Date Last Cleaned:_____
4. 550 Hour Intervals: Replace sampler motor brushes and inspect armature, motor shaft, motor gaskets, motor wiring, and flow meter tubing.
   Date brushes replaced:_____
5. Six-Month Interval: Calibrate sampler. Date last calibrated_____ .
   Elapsed time meter reading:_____

Date	Comments or Maintenance Performed

Reviewed By:_____ Date:_____

MLD-36vfc (5/95)

Figure P.3.2.1
Monthly Quality Control Maintenance Checksheet